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Exploring options in revision shoulder arthroplasty: Is a humeral stem necessary in revision reverse shoulders?

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Abstract

Background: Traditionally, revision of stemmed arthroplasty necessitated the use of longer stem. In young patients, preservation of bone stock is crucial for possible further operations and prevent stress shielding and further bone loss.
Aim: To analyse the clinical and radiological outcomes of a series of patients who underwent revision shoulder arthroplasty, in whom the primary implant was stemmed total shoulder arthroplasty (TSA) and the implant for revision surgery was a stemless metaphyseal reverse TSA without a stem expanding to the humeral diaphysis.
Methods: Between 2010 and 2020, 10 patients (6M; 4F) underwent revision arthroplasty from long stemmed to short metaphyseal stemless rTSA due to pain and disfunction, implant instability and dislocation, cases of loosening and infection. The mean age at surgery was 67 ± 12.2 years. The stemmed implants revised were from different design and manufacturers (Biomet, Lima, Zimmer and Exactech). Impaction with bone graft substitute was used in all cases to fill the void on the humeral side together with antibiotic impregnated Calcium sulfate (Stimulan) beads, in infection cases or in suspicion of low-grade infection. Patients were assessed clinically with the Constant score (CS), Subjective Shoulder Value (SSV), Satisfaction and Radiologic assessment at 3, 6 and 12 months post-operatively, and annually thereafter.
Results: The mean follow-up was 69 months (24–144). Mean CS improved from 16.2 (4–35) to 72.1 (67–85), age/sex adjusted CS from 20.4 to 98.5 ($p < 0.005$). The mean SSV increased from 0.5/10 pre-operatively to 9/10 in the last follow-up. All the patients showed improvements in pain Range of motion and function. Post revision the metaphyseal stemless implants showed solid fixation in the humerus without any lucent lines, loosening, subsidence or evidence of stress shielding, with good new bone formation and filling of the intramedullary canal. In two patients, an implant tilt with perforation of the lateral cortex occurred in the first three weeks post-operatively due to weak cortical bone. The implants settled and remained stable in its new tilted position with conservative treatment, with new bone that was formed around the implants with solid long-term fixation.
Conclusions: Revision of a long-stemmed prosthesis with a stemless-metaphyseal one is feasible and a better option, if the metaphyseal cortical envelope is preserved on removal of the stemmed implant. Good outcome is achieved with good fixation of the stemless-metaphyseal implant and preservation of bone stock. However, implant design is pivotal in achieving immediate stability, resistance to torque and good stress distribution. The use of these implants in revision surgery enables surgeons to take 'a step back' in the patient's journey, preserve and 'create' more bone stock.

Keywords

Reverse total shoulder arthroplasty, revision shoulder arthroplasty, bone stock, stemmed humeral component, stemless, metaphyseal humeral component

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Introduction

Number of shoulder arthroplasties performed are increasing year on year, consequently, the number of revision shoulder arthroplasties are on the rise. The estimated rate of revision for failed shoulder arthroplasties has been shown to represent up to 10% of all shoulder arthroplasties.[1–4]

Over the past decades, there has been much debate about how to optimally fix the humeral component. Initially, cement fixation of the humeral component was considered to be standard practice,[5] but with the development of newer implants it has been shown to be no longer necessary.[6–8]

The concept that there is no need for a stem in shoulder arthroplasty was first introduced by Copeland and Levy,[9–16] since the mid-80s with the success of the Copeland shoulder resurfacing. Following its long-term success, stemless implants were introduced in the mid-2000s and rely on proximal fixation in the humeral metaphysis.[11] This offers advantages of preserved bone stock, less stress shielding, eliminating the diaphyseal stress riser, and ease of stem removal at revision. A recent literature review concluded that stemless component in anatomic total shoulder arthroplasty (TSA) is a 'promising option', with benefits of reduced operative time, improved radiographic outcomes, and showed significantly improved functional outcomes with similar revision and complication rates compared to stemmed implants.[17]

Despite recent developments and excellent results reported with stemless metaphyseal reverse implants without a diaphyseal stem,[18–24] some authors still express concern about the humeral fixation in reverse total shoulder arthroplasty (rTSA).[25] Humeral implant subsidence or loosening may occur with humeral stems that are historically round by design, and therefore offer little resistance to rotational torque, particularly of concern as rTSA is a semi-constrained[25] implant. Growing evidence is promising regarding the use of stemless metaphyseal rTSA with specific design characters that show good patient outcomes, clinically and radiographically, with long-term studies.[18–2326–33]

In the realm of revision shoulder arthroplasty involving compromised bone stock, apprehension may arise regarding the initial primary press-fit fixation of a metaphyseal humeral component in the absence of a stem.[15–23] In this scenario, securing primary fixation of the implant is crucial to prevent loosening and the necessity for revision surgery. Implant design assumes a pivotal role in counteracting the forces exerted on the proximal humerus, particularly during rotational movements. Additionally, the choice of fixation method and effective management of bone stock are paramount considerations.

While stemless metaphyseal implants are well described in primary rTSA,[18,2426–35] limited evidence exists for their use in revision settings. This is the first study describing outcomes of a series of patients that had revision shoulder arthroplasty from an index stemmed humeral component to a stemless metaphyseal humeral component, without a diaphyseal stem.

The aim of this study was to describe the clinical and radiological outcomes of a series of patients that underwent revision shoulder arthroplasty, from a primary stemmed implant to a stemless metaphyseal implant without diaphyseal stem.

Materials and methods

A retrospective review was conducted of prospectively collected data on patients that underwent revision shoulder arthroplasty at our institution between 2010 and 2020.

During this period, 66 shoulders were revised to rTSA. Of them, 44 were revised from resurfacing and stemless anatomic shoulders to stemless reverse TSA; 12 shoulders were revised from stemmed implants to stemmed reverse TSA; and 10 shoulders were revised from a stemmed implant to a stemless metaphyseal rTSA, without a diaphyseal stem.

Demographics

A total of 10 patients (6 male, 4 female) were identified from a single-surgeon, single-centre cohort. The mean age at the time of revision surgery was 67 ± 12.2 years old (range 39–83). The mean follow-up period after revision was 69 months (range 24–144). Table 1 summarises the characteristics of the study population.

Inclusion and exclusion criteria

The leading concept of the senior author (OL) in revision arthroplasty is bone preservation, aiming to revise to stemless reverse TSA in all cases, if possible. If the proximal humeral bone can be preserved, especially the metaphyseal cortical shell, it enables bone graft substitute impaction to be contained and the new stemless implant securely fixed.

Only in cases where the proximal humerus/metaphyseal bone stock was poor or absent, either due resorption and stress-shielding around the previous implant or consequent substantial bone loss during the removal of the stemmed implant in the revision arthroplasty, the use of stemless reverse implant was contraindicated. In these revision cases, with poor proximal bone stock, stemmed reverse TSA was used.

Infection or suspected infection was not a contraindication or exclusion criteria. Therefore, all patients presenting for revision arthroplasty in our institution were initially considered for revision to a stemless reverse TSA, only in cases with poor proximal humerus/metaphyseal bone stock, a stemmed reverse TSA was used.

All the 10 patients in the current study had their initial arthroplasties elsewhere and were referred to our unit for

Table 1. Patients demographics and details.

	Sex	DOB	Age at surgery	Follow-up (months)	Laterality	Implants history	Number of revisions (with prior revisions)	Revised implant	Original diagnosis	Reason for revision	Details of operation	Complications
1	Female	8/1/1958	57	85	Right	CSRA-1990. Revised to Stemmed Nottingham TSA-1997	2	Biomet Stemmed Nottingham TSA	JRA	Pain & Disfunction – Pseudoparalysis + Loosening	Bone substitute humerus, Stimulan	In the first 3 weeks post-operative – Tilt of the implant with perforation of the lateral cortex – healed well around the perforated tip of the implant with good bone formation and good function
2	Male	10/05/ 1945	66	131	Left	Stemmed Nottingham Hemi	1	Biomet Stemmed Nottingham Hemiarthroplasty	Fx sequelae	Pain & Disfunction – Pseudoparalysis	Stimulan	None
3	Male	30/11/ 1947	67	37	Left	Biomet comprehensive reverse Oct 2012 for cuff arthropathy / disengagement of glenosphere / several revisions for dislocations/ eventually got Infected – 23 April 2013 revised to hemiarthroplasty for low-grade infection	6	Biomet comprehensive reverse TSA/ Hemi	CTA	Pain & Disfunction – Severe Pseudoparalysis Severe Antero-Superior escape	Humerus and glenoid bone graft substitute – stimulan + TCP	None
4	Female	28/5/ 1971	39	144	Right	Plateing – Brachial plexus and Brachial artery injury, AVN – Stemmed Nottingham Hemi	3	Biomet Stemmed Nottingham Hemiarthroplasty	Fx sequelae	Severe Pain & Severe Disfunction – Pseudoparalysis	Stimulan + TCP	None
5	Male	22/1/ 1948	67	82	Right	CSRA revised to Lima TSA	2	Lima Stemmed TSA	OA	Infected with fistula with pus – Staph Aureus (Single stage)	TCP and Stimulan, 70cc, Bone substitute glenoid and humerus	None

(continued)

Table 1. Continued.

	Sex	DOB	Age at surgery	Follow-up (months)	Laterality	Implants history	Number of revisions (with prior revisions)	Revised implant	Original diagnosis	Reason for revision	Details of operation	Complications
6	Female	30/05/1946	65	68	Right	CSRA revised to Stemmed Equinoxe TSA	2	Exactech Stemmed Equinoxe TSA	OA	Dislocation, Instability and pain, severe dysfunction	TCP + Stimulan	Humeral metaphyseal crack – Healed completely
7	Male	3/3/1931	83	25	Right	Biomet Comprehensive reverse	1	Biomet Comprehensive reverse	CTA	Pain & loosening glenoid component Infected? (Single stage)	Bone graft substitute humerus and glenoid – Stimulan (Use of long screw baseplate)	None
8	Male	01/11/1948	68	11	Right	Exactech Equinoxe TSA	1	Exactech Equinoxe TSA	OA	Dislocation, Instability and pain, severe dysfunction	Equinox central peg not removed, because extractor didn't engage + Stimulan	None
9	Female	11/4/1944	76	21	Right	Exactech Equinox Hemiarthroplasty	1	Exactech Equinoxe Hemiarthroplasty	OA	Painful – infected (Single stage)	glenoid wear loosening, Stimulan beads	In the first 3 weeks post-operative – Tilt of the implant with perforation of the lateral cortex – healed well around the perforated tip of the implant with good bone formation and good function
10	Male	01/01/1940	78	48	Right	Zimmer TSA	1	Zimmer TSA	OA	Painful – Infected Loosening C. Acnes (Single stage)	Both glenoid and humerus – Stimulan + Bone graft substitute	None

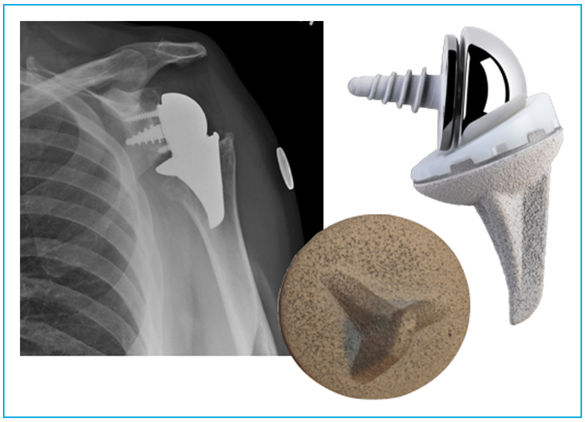

Figure 1. The design of the stemless metaphyseal implant (without a diaphyseal stem) used in the revisions (Verso, Innovative Design Orthopaedics, Theale, UK). The stemless metaphyseal implant design – only three thin tapered fins.

revision. All of them underwent revision to stemless metaphyseal rTSA with the Verso shoulder (Innovative Design Orthopaedics, Theale, Reading, UK; formerly, Biomet, Swindon, UK).

Description of the Verso shoulder and surgical technique

The Verso humeral component is a stemless metaphyseal implant with three tapered thin fins that give immediate metaphyseal fixation when impacted into the cancellous humeral metaphysis (Figure 1). The implant does not violate the humeral diaphysis and does not have a diaphyseal stem. These fins have titanium porous and hydroxyapatite coatings to improve the biologic fixation of the implant. The metaphyseal bone quality or osteoporosis is not a contraindication for the use of this metaphyseal implant, by utilising bone graft impaction technique either from the resected humeral head or with bone graft substitute in revision cases. The shape of the implant provides immediate mechanical rotational stability and resistance to tilting forces.

The surgical technique was previously described.[23]

Indications for surgery

Five of the patients had at least one prior revision TSA. Three patients had two previous revisions, and one patient had five revision surgeries prior to the current revision (Table 1). The indications for the primary operation were cuff tear arthropathy (2/10), fracture sequelae (2/10), juvenile rheumatoid arthritis (1/10) and primary osteoarthritis (5/10).

The indications for revision surgery were pain and dysfunction with pseudoparalysis in all the patients. Three patients had a stemmed Nottingham shoulder arthroplasty (Biomet, Warsaw, IN, USA); two (2 & 4) with hemi arthroplasty for fracture sequelae and one patient with stemmed Nottingham TSA (Biomet, Warsaw, IN, USA) for Juvenile Rheumatoid arthritis. This patient also had loosening on radiographs and was treated as low-grade infection. Three patients had Equinoxe implants (Exactech, Gainesville, FL, USA); two TSAs (6 & 8) and one hemiarthroplasty (9). The two patients with Equinoxe TSA had dislocation of the implants and severe dysfunction. Both suffered from Parkinson's disease. The patient with the Equinoxe hemiarthroplasty had infected loosening with dysfunction.

One patient with a stemmed Bigliani-Flatow TSA (Zimmer Warsaw, IN, USA) (10) with pain and dysfunction since the index operation 12 years earlier was found to have loosening secondary to infection with *C. acnes*. One patient with a stemmed Lima SMR TSA (Lima Corporate, UD, Italy) (5) was found to have severe infection, with pus draining from a fistula (*s. aureus*). Two patients were referred with failed Biomet Comprehensive rTSA (3 & 7). One presented with dislocation and loosening and displacement of the baseplate (7). The other patient presented with recurrent episodes of disengagement of the gleno-sphere, and recurrent dislocations. After four revisions and reductions, the prosthesis became infected and revised to a hemiarthroplasty. Both were referred to our unit with severe dysfunction, pseudoparalysis and severe antero-superior escape (Figure 3).

Management of infected cases

In the policy of our unit, all cases of painful arthroplasty or with loosening for revision surgery are suspected to be infected. All were treated by a single-stage revision.

During the revision, multiple samples were taken for microbiology and histology (minimum of 5 samples), thorough debridement, washout and antibiotic loaded absorbable calcium sulphate beads 10cc (Stimulan, Biocomposites, Keele UK), loaded with 1 g vancomycin and 240 mg gentamicin were used in these cases. Antibiotic therapy was started according to the culture sensitivity as per microbiology advice.

Surgical technique

The anterosuperior (Neviaser-Mackenzie) approach[36] was used in all cases. If the previous arthroplasty was performed through the Deltopectoral approach, the old deltopectoral skin incision was used, with the anterosuperior approach performed subcutaneously. In all cases local antibiotic treatment with absorbable calcium sulphate beads 10cc (Stimulan, Biocomposites, Keele UK) loaded with 1 g vancomycin and 240 mg gentamicin were used. The beads were added to the bone graft used in the humerus impacted

Figure 2. (Patient 3). 57-year carpenter with failed left Biomet comprehensive reverse TSA. He had five revisions and reoperations prior to the current revision. (A) Post-operative X-ray after comprehensive rTSA (elsewhere). (B) Disengagement of the glenosphere. (C) After revision to reposition the glenosphere. (D) Dislocation of the rTSA. (E) Following several revisions and dislocations, developed low-grade infection, revised to hemiarthroplasty. (F) Presentation with severe pseudoparalysis and antero-superior escape. (G) Removal of the stemmed implant while preserving the proximal humerus cortical envelope. (H) Intra-operative X-rays – revision with stemless metaphyseal implant (without a diaphyseal stem) with bone graft substitute and Stimulan beads impaction. (I) AP and axillary X-rays at the last follow-up – note that the humeral canal is filled with new bone! (J) Clinical Outcome - range of motion at the last follow-up.

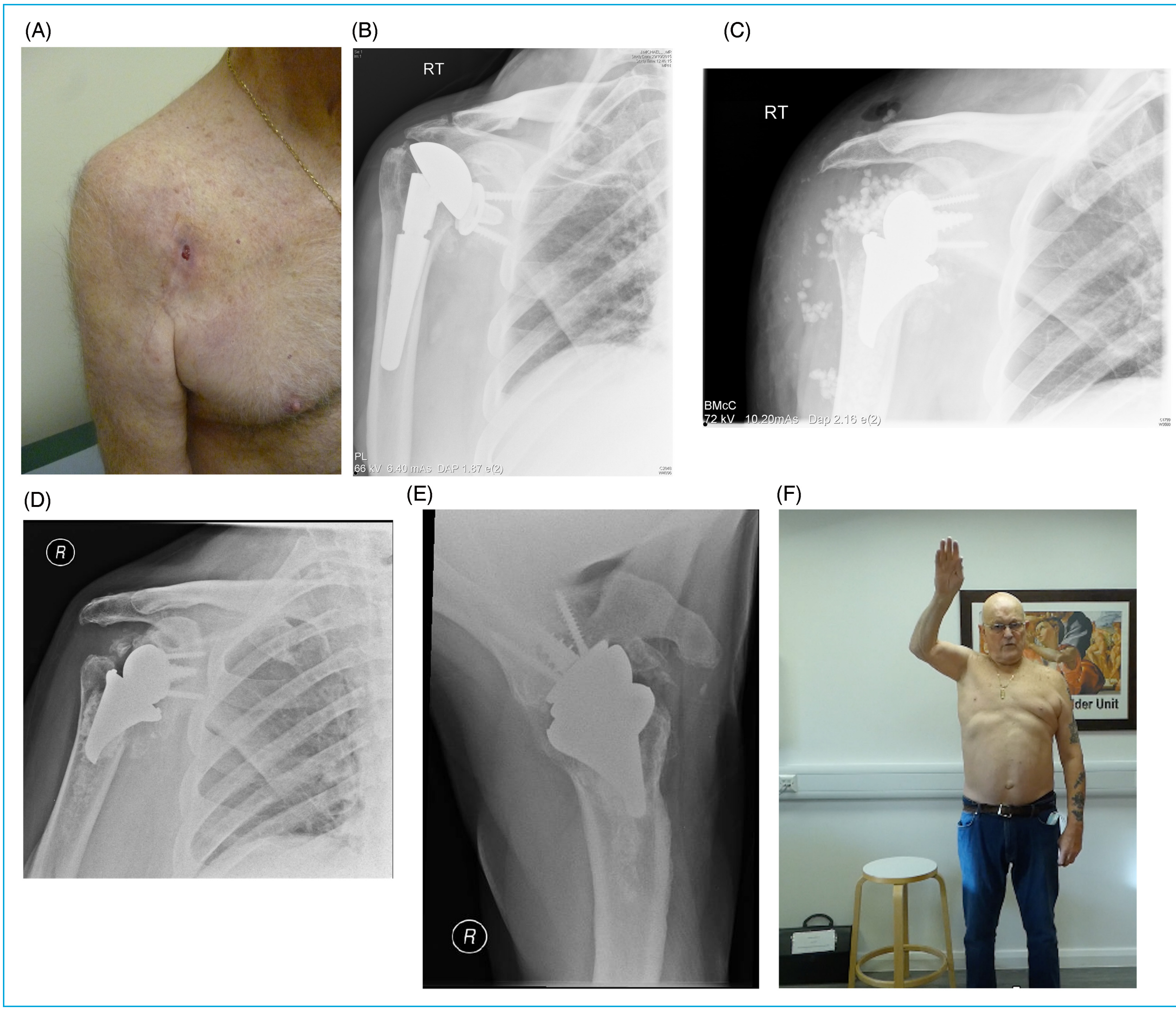

Figure 3. (Patient 5). (A) 67 years with hematogenic infected stemmed Lima TSA (Staph. Aureus) with fistula. (B) X-rays infected stemmed Lima TSA. (C) Immediate post-operative X-rays with the stemless metaphyseal stemless rTSA with Stimulan beads. (D, E) X-rays at last follow-up, over 10 years after the revision TSA, showing formation of new bone in the metaphysis and the medullary canal following the bone graft substitute + Stimulan impaction. (F) Clinical outcome at last follow-up, over 10 years after the revision TSA.

into the bone, as well as, with any bone graft needed to restore bone stock on the glenoid side; additional beads were added between the soft tissues and the joint space.

Revision from stemmed implants to a stemless metaphyseal implant was possible only if the stemmed implant could be removed whilst preserving the proximal cortical bone envelope of the humerus.

Bone graft impaction with the bone graft substitute (Granules or Putty) was used in all the cases to impact and fill the metaphyseal and the intramedullary void left by the removed stem; the implant trial was used to achieve optimal compression and impaction of the bone graft. The process of bone impaction was repeated until satisfactory bone compaction was achieved. The Verso (Innovative Design Orthopaedics, Theale, Reading, UK) stemless metaphyseal implant was used in all the revisions (Figure 1).

An intra-operative humeral metaphyseal periprosthetic nondisplaced fracture occurred in one patient (6) and was managed by means of a PDS cord cerclage. It subsequently healed uneventfully. In patient 8 with the Equinoxe TSA, the central glenoid peg could not be removed, and was therefore retained in the bone, with the baseplate and screws placed without compromise to the fixation.

Patient evaluation

Patient evaluation was performed by an independent observer pre-operatively and post-operatively at 3, 6, 9, 12 and 24 months, and annually thereafter. Shoulder functionality was assessed with the Constant score (CS), age- and sex-adjusted CS, Subjective Shoulder Value (SSV)[37] and Patient satisfaction. Pain relief was assessed on visual

Table 2. Stratified clinical outcomes.

Quality of life evaluations	Pre-operative assessment	Last follow-up assessment	*p-value*
Pain level 0–15	8.6 ± 3.8	1.9 ± 1.9	0.0001
Global satisfaction (0–10)	0.5 ± 0.97	9 ± 1.15	0.0001
Constant score (Raw score)	16.2 ± 9.8	72.1 ± 5.3	0.0001
Age /Sex adjusted Constant score (%)	20.4 ± 12.5	98.5 ± 11.8	0.0001
Forward flexion (Degrees)	55 ± 39.2	161 ± 16.6	0.0001
Abduction (Degrees)	40 ± 24.5	152 ± 24.4	0.0001
External rotation in adduction (Degrees)	21 ± 19.1	38.5 ± 21.4	0.01
Internal rotation in abduction (Degrees)	19 ± 28.5	83 ± 9.5	0.0001
Strength (kilos)	0.16 ± 0.00	4.1 ± 1.53	0.0001
Strength (Lbs)	0.35 ± 0.00	9.02 ± 3.37	0.0001

analogue scales from 0 to 15. Video recording of range of movements and function was obtained for all patients pre-operatively and at regular intervals after surgery at all the follow-up appointments. Radiographic analysis was performed by two shoulder surgery consultants (OL, PC) using a template form, assessing true anteroposterior and axillary views of the shoulder. If there was disagreement, a third shoulder surgery consultant was consulted (GS).

Results

Clinical outcomes

Significant improvements in all the parameters of the CS were observed. Mean CS improved from 16.2 (4–35) to 72.1 (67–85). Age/sex adjusted CS improved from 20.4 to 98.5 ($p < 0.005$). The mean SSV increased from 0.5/10 pre-operatively to 9/10 in the last follow-up. All the patients showed significant improvements in pain, range of motion in all planes of motion and function. All patients regained good functional range of motion. Table 2 summarises the stratified clinical outcomes (Table 2).

Radiological outcomes

Immediate post-operative X-rays showed the implants in place with the bone graft substitute and the Stimulan beads.

In two patients (1 & 9), the intra-operative and the immediate post-operative X-rays showed good position of the stemless metaphyseal implant. Unfortunately, early in the first three weeks post-operatively, the tip of the implant tilted and perforated the lateral cortex due to soft weak cortical bone. These cases were treated conservatively, and the implants settled in its tilted position and demonstrated subsequent good bone healing and new bone formation around the implant. Both patients regained good and satisfactory shoulder function (Figure 5).

No radiolucencies, nor signs of late loosening were observed in any of the cases. In one case, grade 2 glenoid notching was seen, without any clinical significance. No proximal bone resorption and no subsidence was observed in any of the cases.

Statistical analysis

Data was analysed using the SPSS statistical package (SPSS, Chicago, IL, USA). The t test was applied to analyse quantitative variables and the χ^2 test for categorical variables. The χ^2 test and analysis of variance were used to compare pre-operative and post-operative results. Continuous variables are presented as mean and standard deviation. Categorical variables are presented as percentages and frequencies. The relationship between the variables was analysed with contingency tables for the categorical variables, and the inference was studied with the χ^2 test or Fisher exact test depending on what corresponded. The inference in continuous variables was calculated with the paired-samples t test, and the results are presented with the corresponding standard deviations. The level of significance was set at 5% ($\alpha = 0.05$).

Improvement, or gain, in both functionality and patient satisfaction was calculated for each case by comparing the

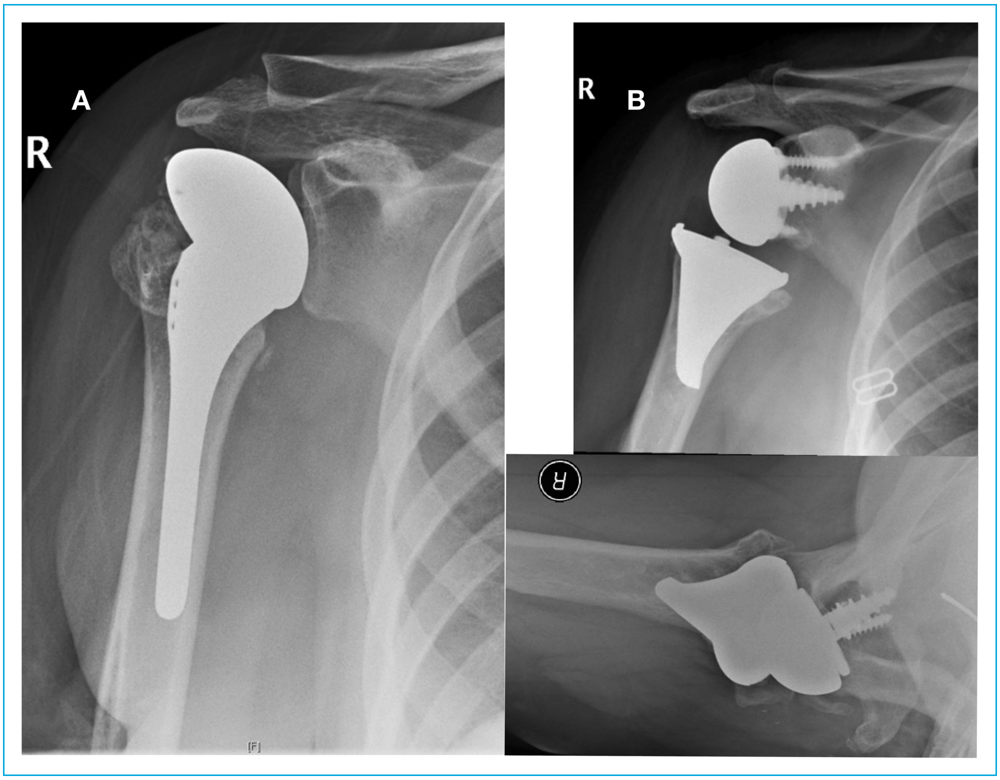

Figure 4. (Patient 4). (A) The stemmed Biomet Nottingham Hemiarthroplasty. (B) X-rays at last follow-up, over 12 years after the revision TSA, showing formation of new bone in the metaphysis and the medullary canal.

latest observed post-operative value with the corresponding pre-operative value, and the significance of the difference was tested using the paired *t* test. Improvements over time (pre-operatively, immediately post-operatively, and at last follow-up) in the CS and SSV were assessed using all clinical data.

Discussion

This study shows that stemless metaphyseal rTSA can be considered for revision shoulder arthroplasty even in cases where the index operation used a stemmed humeral component. Achieving primary stability of the implant is crucial and should be maintained over time. Therefore, implant design features and surgical technique plays an important role.

Historically, shoulder replacement designs relied on diaphyseal fixation. Boileau et al. claimed that fixation of a reverse TSA may be more problematic on the humeral side than on the glenoid side.[25] Some of these concerns, regarding implant subsidence or loosening, are related to the humeral stem cylindric and round design that offer little resistance to rotational torque.[25] A diaphyseal fixation may lead to stress shielding of the proximal humerus with bone reabsorption. As per Wolff's law, repetitive loading of bone will cause adaptive responses enabling the bone to better cope with these loads.[38] Bone which is not loaded, will eventually reabsorb (osteopenia)[39] as reported for stemmed humeral components.[8] Raiss et al. described radiographic evidence of stress shielding in as many as 82.5% of traditional humeral components.[8] Severe stress shielding was reported even with short-stemmed implants.[33]

Direct loading of the metaphyseal bone is crucial to prevent stress shielding and bone resorption.[20] There is a clear definition between a stemless metaphyseal implant and a short stem implant. A short stem implant has a diaphyseal component (although short), whereas a stemless metaphyseal implant is confined to the metaphysis regardless its shape: pointed or rounded. The Verso stemless implants are less than 50 mm length.

Denard at al. proposed a classification in 2018[40]; they stipulated that a stemless implant must be shorter than 50 mm, while a short stem is an implant with a length ranging between 50 and 100 mm.

Implant design is pivotal in achieving immediate mechanical fixation providing resistance to torque forces. The triple finned humeral component design stands out for its ability to deliver immediate cancellous metaphyseal fixation and robust resistance to rotational torque and varus-valgus forces. It provides good stress distribution under the implant to the metaphyseal cancellous bone. The Titanium porous and hydroxyapatite coatings on the

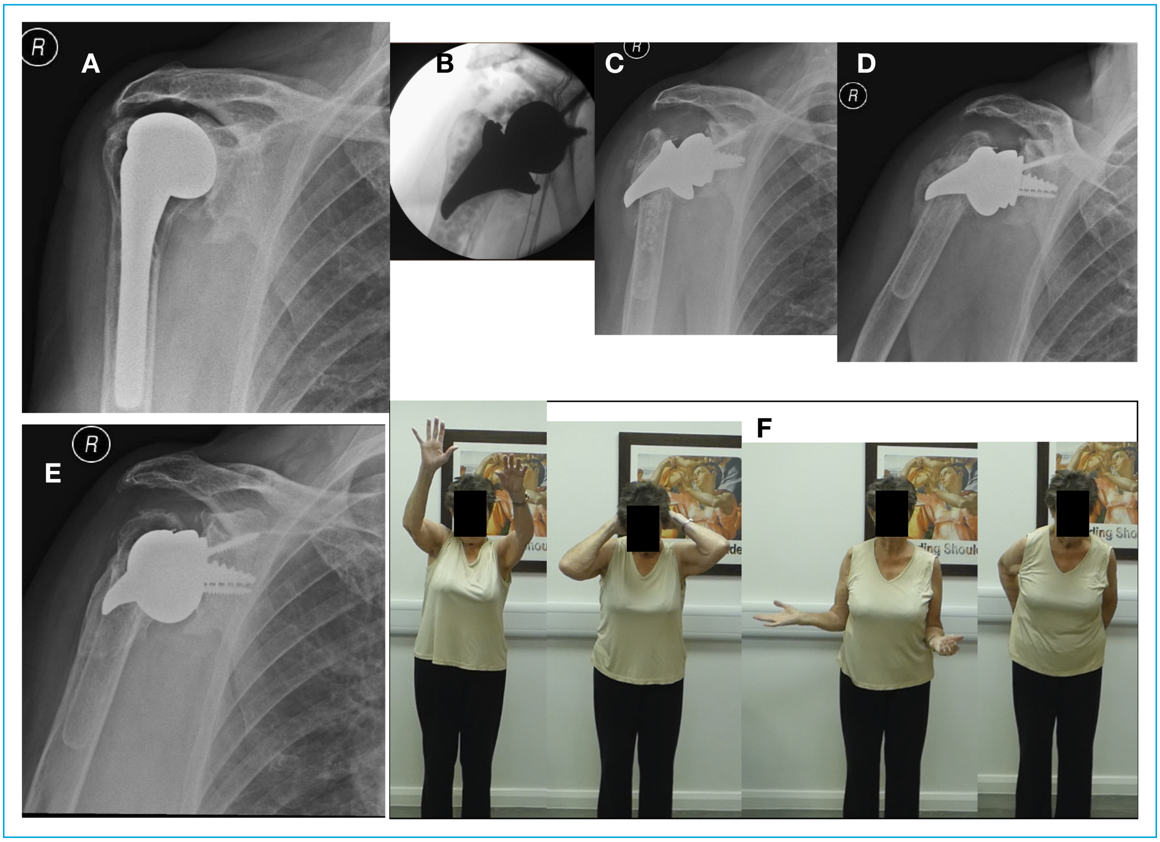

Figure 5. (Patient 9). (A) The stemmed Exactech Equinoxe Hemiarthroplasty with loosening. (B) Intra-operative X-rays of the revision with the stemless metaphyseal rTSA with stimulan beads. (C) Three weeks post-operative – tilting and perforation of the lateral cortex noted due to weak soft cortical bone. (D) The implant settled and remained stable in its new tilted position with conservative treatment, with new bone formation around the implants and solid fixation. (E) X-rays at 2 years follow-up post revision. Further new bone was formed with remodelling around the implant with solid long-term fixation. (F) Good clinical outcome – range of motion at the latest follow-up.

implant surface facilitate further secondary biologic osteointegration, ensuring enduring stability over time. The bone graft impaction technique used in these cases significantly improved the bone stock in the proximal humerus.[18–30]

In all the cases, new bone formation was observed in the medullary canal and around the metaphyseal implants, in the space within the bone where the primary long stem occupied (Figures 2–5).

The two patients where initial tilting and lateral humeral cortex perforation appeared, the implant settled and remained stable in its new tilted position with conservative treatment, with new bone formation around the implants with solid long-term fixation (Figure 5) and good functional outcome.

Although this tilting and lateral cortex failure is not desirable, these cases settled in the new tilted position with new bone formation around the implants and solid long-term fixation with good clinical outcome and function demonstrate that with this design features this implant is stable even in these undesirable situations.

The clinical outcome of the stemless anatomic shoulder arthroplasty are at least equal to these of the stemmed implants.[41] Growing number of studies has demonstrated promising results with stemless metaphyseal reverse TSA in the mid-term to long-term.[18,2426–35] Excellent pain relief and restoration of good active range of motion were achieved in the majority of treated patients with restoration of the shoulder function and high patient satisfaction.[18,2426–35]

Use of stemless metaphyseal reverse TSA not only shows good clinical outcome and is not inferior to stemmed implants. Furthermore, the bone stock around the implant is much better compared to the pre-revision state.[22–33] Should the need for future revision arise, the use of stemless metaphyseal implant keeps all future options open.

These are small number of cases, individually selected as suitable for revision with a stemless metaphyseal implant.

However, the first choice of the senior author in revision arthroplasty is to revise to stemless implant. Only when it is not suitable, to use stemmed implant.

Conclusion

This case series showed that stemless metaphyseal rTSA can be considered in revision arthroplasty of stemmed implants with good long-term clinical and radiological results. Embracing stemless metaphyseal bone-preserving implants not only addresses the immediate needs of these individuals but also safeguards their options for future interventions. This proactive approach aligns seamlessly with the dynamic landscape of shoulder arthroplasty, particularly as the demand for revision procedures is poised to escalate.

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